

AMENDMENTS TO THE CLAIMS:

1. (Currently amended) A hologram recording medium, comprising: ~~which is made of~~ a photo refractive crystal of a uniaxial crystal having surfaces in a shape of parallel flat plates, said photo refractive crystal comprising: ~~and has~~
a plurality of areas of a refractive index grating corresponding to one portion of a three-dimensional light interference pattern of a coherent signal light beam and coherent reference light of a first wavelength modulated in accordance with information data,
wherein ~~each of~~ the areas of said refractive index grating have ~~has~~ a columnar shape, and ~~the areas of said refractive index grating~~ are adjacently arranged in parallel with each other.
2. (Currently Amended) A hologram recording medium according to claim 1, wherein the photo refractive crystal comprises ~~is~~ a crystal having a recording sensitivity at said first wavelength that increases when a gate light beam of a second wavelength is simultaneously irradiated in addition to the reference light and the signal light of said first wavelength.
3. (Original) A hologram recording medium according to claim 1, wherein the photo refractive crystal has an optical crystal axis which is one of approximately parallel and approximately ~~or~~ perpendicular to a main surface of the recording medium.
4. (Original) A hologram recording medium according to claim 1, wherein information data of one screen are stored in areas of said refractive index grating.
5. (Original) A hologram recording medium according to claim 1, wherein each of the areas of said refractive index grating of the columnar shape extends approximately perpendicularly to the main surface of the hologram recording medium.
6. (Currently amended) A hologram recording medium according to claim 1, wherein each of the areas of said refractive index grating of the columnar shape comprises ~~an~~ approximately ~~has a~~ cylindrical shape.

7. (Original) A hologram recording medium according to claim 1, wherein a maximum inside diameter of the areas of said refractive index grating is smaller than the distance between peaks of zeroth-order and primary diffracted lights of a light intensity distribution of said signal light beam.

8-16. (Previously canceled)

17. (Original) A hologram recording and reproducing apparatus for forming a plurality of areas of a refractive index grating corresponding to one portion of a three-dimensional light interference pattern of a coherent signal light beam and coherent reference light of a first wavelength modulated in accordance with information data within a recording medium made of a photo refractive crystal of a uniaxial crystal having a parallel flat plate shape, said hologram recording and reproducing apparatus comprising:

- a supporting part for detachably holding the recording medium made of the photo refractive crystal having the parallel flat plate shape;

- a reference light part for making a coherent recording reference light beam of a first wavelength approximately perpendicularly incident to a main surface of said recording medium;

- a signal light part for making the coherent signal light beam of the first wavelength modulated in accordance with the information data of one screen incident to said recording medium, and making the coherent signal light beam cross said recording reference light beam within the recording medium, and generating a light interference pattern of said signal light beam and the recording reference light beam;

- a gate light part for making a gate light beam of a second wavelength for revealing recording sensitivity of the recording medium approximately perpendicularly incident to the main surface of said recording medium together with said recording reference light beam, and forming a refractive index grating of one portion of said light interference pattern which passes through a portion of said recording medium for crossing said signal light beam and the recording reference light beam and demarcates a volume smaller than that of this crossing portion;

a phase conjugate wave generating part for generating a phase conjugate wave with respect to said signal light beam by irradiating a reproducing reference light beam coaxial with respect to said recording reference light beam and propagated in an opposite direction to said refractive index grating of said recording medium;

a separating part for separating said phase conjugate wave from an optical path of said signal light beam; and

a detecting part for detecting the information data formed as an image by said phase conjugate wave.

18. (Original) A hologram recording and reproducing apparatus according to claim 17, wherein the hologram recording and reproducing apparatus further comprises a part for converging said gate light beam and said recording medium is arranged in the vicinity reaching a waist of said gate light beam, and the areas of said refractive index grating are formed in a columnar shape and are adjacently arranged in parallel with each other.

19. (Original) A hologram recording and reproducing apparatus according to claim 17, wherein said recording medium has an optical crystal axis approximately parallel or perpendicular to a main surface of the recording medium.

20. (Original) A hologram recording and reproducing apparatus according to claim 17, wherein the hologram recording and reproducing apparatus further comprises a part for coaxially irradiating said recording reference light beam and said gate light beam.

21. (Original) A hologram recording and reproducing apparatus according to claim 17, wherein the hologram recording and reproducing apparatus further comprises a part for converging said recording reference light beam.

22. (Original) A hologram recording and reproducing apparatus according to claim 17, wherein said recording reference light beam and said gate light beam are approximately perpendicularly irradiated to a main surface of said recording medium, and the areas of said

refractive index grating of the columnar shape are approximately perpendicularly extended to the main surface of said recording medium.

23. (Original) A hologram recording and reproducing apparatus according to claim 17, wherein the gate light beam and the signal light beam are respectively irradiated such that a cross sectional area of said gate light beam on the surface of said recording medium is smaller than that of said signal light beam.

24. (Original) A hologram recording and reproducing apparatus according to claim 17, wherein each of the areas of said refractive index grating of the columnar shape is approximately formed in a cylindrical shape.

25. (Original) A hologram recording and reproducing apparatus according to claim 17, wherein a maximum inside diameter of the areas of said refractive index grating is smaller than the distance between peaks of zeroth-order and primary diffracted light beams of a light intensity distribution of said signal light beam.

26. (Currently amended) A hologram recording and reproducing method for recording and reproducing information using a hologram, comprising:

~~a recording step including the steps of;~~

providing a recording medium made of a photo-refractive crystal of a uniaxial crystal having a shape of parallel flat plates;

converging a coherent recording reference light beam onto said recording medium arranged at an upstream side and in a vicinity of a beam waist of the recording reference light beam passing there through in such manner that said recording reference light beam is irradiated to a main surface of said recording medium; ~~and~~

converging a coherent signal light beam of a first wavelength modulated in accordance with information data onto said recording medium to intersect with the recording reference light beam within said recording medium to form a region of the refractive index grating in a columnar shape extended from the main surface of said recording medium, so that a plurality of the regions of the refractive index grating can be adjacently arranged in

parallel with each other correspondingly to a portion of a three-dimensional optical interference pattern of the signal light beam and the reference light beam; and

~~a reproducing step including the steps of;~~

converging and passing the recording reference light beam to the main surface of said recording medium; and

reflecting the recording reference light beam at the beam waist or its vicinity thereof to generate a reproducing reference light beam coaxial with the recording reference light beam going back to said recording medium to propagate the reproducing reference light beam in an opposite direction into said refractive index grating of said recording medium to generate a phase conjugate wave.

27. (Previously canceled)

28. (Original) A hologram recording and reproducing method according to claim 26, wherein said recording medium has an optical crystal axis approximately parallel or perpendicular to the main surface of the recording medium.

29-30. (Previously canceled)

31. (Original) A hologram recording and reproducing method according to claim 26, wherein a maximum inside diameter of the areas of said refractive index grating is smaller than the distance between peaks of zeroth-order and primary diffracted lights of a light intensity distribution of said signal light beam.

32. (Original) A hologram recording and reproducing apparatus for forming plural areas of a refractive index grating corresponding to one portion of a three-dimensional optical interference pattern of a coherent signal light beam and coherent reference light of a first wavelength modulated in accordance with information data within a recording medium constructed by a photo-refractive crystal of a uniaxial crystal having a parallel flat plate shape, said hologram recording and reproducing apparatus comprising:

a supporting part for detachably holding the recording medium constructed by the photo-refractive crystal having the parallel flat plate shape;

a reference light part for making a coherent recording reference light beam of the first wavelength convergent and approximately perpendicularly incident to a main surface of said recording medium;

a signal light part for making the coherent signal light beam of the first wavelength modulated in accordance with the information data of one screen incident to said recording medium, and making the coherent signal light beam cross said recording reference light beam within the recording medium, and generating a optical interference pattern of said signal light beam and the recording reference light beam;

a gate light part for making a gate light beam of a second wavelength for enhancing a recording sensitivity of the recording medium convergent and approximately perpendicularly incident to the main surface of said recording medium coaxially with respect to said recording reference light beam, and forming the refractive index grating of one portion of said optical interference pattern which passes through a portion of said recording medium for crossing said signal light beam and the recording reference light beam and demarcates a volume smaller than that of this crossing portion;

a phase conjugate wave generating part which includes a plane mirror arranged in the vicinity of a beam waist of said recording reference light approximately perpendicularly incident to the main surface of said recording medium, and generates a phase conjugate wave with respect to said signal light beam by irradiating a reproducing reference light beam coaxial with respect to said recording reference light beam and propagated in an opposite direction to said refractive index grating of said recording medium by said plane mirror;

a separating part for separating said phase conjugate wave from an optical path of said signal light beam; and

a detecting part for detecting the information data formed as an image by said phase conjugate wave.

33. (Currently Amended) A hologram recording and reproducing apparatus according to claim 32, wherein said supporting part ~~has~~ comprises a moving mechanism for moving said

recording medium such that the areas of said refractive index grating are formed in a columnar shape and are adjacently arranged in parallel with each other.

34. (Original) A hologram recording and reproducing apparatus according to claim 32, wherein said recording medium has an optical crystal axis approximately parallel or perpendicular to the main surface of the recording medium.

35. (Original) A hologram recording and reproducing apparatus according to claim 32, wherein the gate light beam and the signal light beam are respectively irradiated such that a cross sectional area of said gate light beam on the surface of said recording medium is smaller than that of said signal light beam.

36. (New) A hologram recording and reproducing apparatus for forming a plurality of refractive index grating areas within a recording medium, said apparatus comprising:
a gate light part for making a gate light beam of a second wavelength for revealing recording sensitivity of the recording medium approximately perpendicularly incident to the main surface of said recording medium together with a recording reference light beam, and forming a refractive index grating of one portion of a light interference pattern which passes through a portion of said recording medium for crossing a signal light beam and a recording reference light beam and demarcates a volume smaller than that of a crossing portion of said signal light beam and said recording reference light beam.

37. (New) The hologram recording and reproducing apparatus according to claim 36, wherein said gate light beam and said reference light beam are approximately coaxial.

38. (New) The hologram recording and reproducing apparatus according to claim 36, wherein said signal light beam is incident to said recording medium at an acute angle with respect to said reference light beam.